AMENDMENTS TO THE CLAIMS

1. (Previously presented) A friction stir welding system that is capable of functionally friction stir welding high melting temperature ferrous and non-ferrous alloys, and superalloys, in a non-planar weld, said friction stir welding system comprising:

a friction stir welding tool having a superabrasive material disposed on at least a portion of the shoulder and the pin, wherein the friction stir welding tool is disposed on a first side of a non-planar surface; and

a support mandrel disposed against a second side of the non-planar surface so as to counteract a force applied by the friction stir welding tool to the first side.

2. (Previously presented) The system as defined in claim 1 wherein the system further comprises selecting the non-planar surface from the group of non-planar surfaces comprised of a pipe, flange, tank, and a shroud.

3. (Previously presented) The system as defined in claim 2 wherein the system further comprises means for performing longitudinal friction stir welds along the non-planar surface.

4. (Previously presented) The system as defined in claim 3 wherein the system further comprises means for performing radial friction stir welds along the non-planar surface.

5. (Previously presented) The system as defined in claim 4 wherein the system further comprises the first side of the non-planar surface being an outer diameter (OD) of a pipe, and the second side of the non-planar surface being an inner diameter (ID) of the pipe.

6. (Previously presented) The system as defined in claim 5 wherein the system further comprises the first side of the non-planar surface being the ID of a pipe, and the second side of the non-planar surface being an OD of the pipe.

7. (Previously presented) The system as defined in claim 6 wherein the system further comprises the support mandrel including a coating to prevent diffusion bonding with the second side of the non-planar surface.

8. (Previously presented) The system as defined in claim 7 wherein the system further comprises a movable mandrel that is capable of movement along a length of the pipe.

9. (Previously presented) The system as defined in claim 8 wherein the movable mandrel is capable of movement around the ID of the pipe.

10. (Currently amended) The system as defined in claim ~~1~~ 8 wherein the movable mandrel is further comprised of:

an inflatable bladder;

a coiled sheet of material that can function as a surface of the movable mandrel, wherein the inflatable bladder is disposed inside the coiled sheet, and wherein the inflatable bladder can inflate to uncoil the coiled sheet to thereby press against an inner surface of the non-planar surface.

11. (Currently amended) The system as defined in claim ~~1~~ 8 wherein the movable mandrel is further comprised of:

an inflatable bladder;

a segmented material that can function as a surface of the movable mandrel, wherein the inflatable bladder is disposed inside the segmented material, and wherein the inflatable bladder can inflate to cause the segmented material to expand and to thereby press against an inner surface of the non-planar surface.

12. (Currently amended) The system as defined in claim ~~1~~ 8 wherein the movable mandrel is further comprised of a consumable

material, wherein the consumable is disposed so as to be pressed against an inner surface of the non-planar surface, and wherein the consumable material can be removed from the inner surface after friction stir welding is complete, wherein the consumable material provides a counter-force to the friction stir welding tool.

13. (Currently amended) The system as defined in claim ~~1~~ 8 wherein the movable mandrel is further comprised of a system of planetary gears, wherein the planetary gears are capable of movement to thereby cause an outer ring to expand or contract, to thereby provide a counter-force to the friction stir welding tool when expanded.

14. (Currently amended) The system as defined in claim ~~1~~ 8 wherein the movable mandrel is further comprised of a wedge, wherein the wedge is capable of being disposed such that it presses against an inner surface of the non-planar surface by friction.

15. (Currently amended) The system as defined in claim ~~1~~ 8 wherein the movable mandrel is further comprised of a segment of the pin that is disposed on an opposite side of the non-planar surface via a relatively thin connecting segment.

16. (Currently amended) The system as defined in claim ~~1~~ 8 wherein the movable mandrel is comprised of a plunder system, wherein the plunger system is further comprised of:

a stopping block;

a plunger having an arm disposed through the stopping block and a plunger end;

a compressible material disposed between the stopping block and the plunder end, wherein the plunger end is moved towards the stopping block to thereby compress the compressible material, which is turn is compressed against an inner surface of the non-planar material.

17. (Previously presented) A friction stir welding system that is capable of functionally friction stir welding high melting temperature materials, said system comprising:

a friction stir welding tool having a superabrasive material disposed on at least a portion of the friction stir welding tool, wherein the superabrasive material is manufactured under an ultra high temperature and an ultra high pressure process; and

a movable mandrel disposed opposite the friction stir welding tool, to thereby create a counter-force to a pressure exerted by the friction stir welding tool on the high melting temperature materials, to thereby prevent damage to the high

melting temperature materials.

18. (Previously presented) The system as defined in claim 17 wherein the system is further comprised of a clamping system for holding ends of two pipes together in a position that is suitable for friction stir welding of the two pipes.

19. (Previously presented) The system as defined in claim 18 wherein the clamping system is further comprised of a first clamp for holding a first pipe, and a second pipe for holding a second pipe.

20. (Previously presented) The system as defined in claim 19 wherein the clamping system is further comprised of means for rotating the two pipes to enable the friction stir welding tool to remain stationary while the two pipes are rotated underneath the friction stir welding tool.

21. (Previously presented) The system as defined in claim 20 wherein the clamping system is further comprised of means for rotating the friction stir welding tool while the two pipes are held stationary.

22. (Previously presented) The system as defined in claim 21 wherein the movable mandrel is disposed inside the two pipes to prevent damage to the two pipes when the friction stir welding tool is welding the ends of the two pipes together.

23. (Previously presented) The system as defined in claim 22 wherein the movable mandrel is further comprised of an anvil for generating at least three points of contact between the movable mandrel and an inside diameter (ID) of a pipe, wherein one of the at least three points of contact is directly opposite the friction stir welding tool that is pressing against the outside diameter (OD) of the pipe.

24. (Previously presented) The system as defined in claim 23 wherein the anvil for generating the at least three points of contact between the movable mandrel and the ID of the pipe is further comprised of a plurality of pistons, wherein the plurality of pistons are independently controllable to thereby enable at least three to always be in contact with the ID of the pipe.

25. (Previously presented) The system as defined in claim 24 wherein the anvil is further comprised of at least three hoops, wherein the at least three hoops are pushed by the plurality of

pistons, wherein a middle hoop is disposed so as to apply a force opposite the friction stir welding tool, and wherein at least two outer hoops are disposed so as to provide a counter-force to the middle hoop.

26. (Previously presented) The system as defined in claim 25 wherein the at least three hoops can be moved around the ID of the pipe by the plurality of pistons.

27. (Previously presented) A friction stir welding system that is capable of functionally friction stir welding two pipes, said system comprising:

a clamping system for holding ends of the two pipes together in a position that is suitable for friction stir welding of the two pipes; and

a friction stir welding tool having a superabrasive material disposed on at least a portion of the friction stir welding tool, wherein the superabrasive material is manufactured under an ultra high temperature and an ultra high pressure process.

28. (Previously presented) The system as defined in claim 27 wherein the clamping system is further comprised of a first clamp for holding a first pipe, and a second pipe for holding a second pipe.

29. (Previously presented) The system as defined in claim 28 wherein the clamping system is further comprised of means for rotating the two pipes to enable the friction stir welding tool to remain stationary while the two pipes are rotated underneath the friction stir welding tool.

30. (Previously presented) The system as defined in claim 29 wherein the clamping system is further comprised of means for rotating the friction stir welding tool while the two pipes are held stationary.

31. (Previously presented) A movable mandrel for use in friction stir welding of a pipe, wherein the movable mandrel is disposed inside the pipe, said movable mandrel comprising:

an anvil for creating a counter-force to a pressure exerted on an outside diameter (OD) of the pipe, to thereby prevent damage to the pipe; and

a means for moving the movable mandrel along a length of the pipe and around the inside diameter (ID) of the pipe.

32. (Previously presented) The system as defined in claim 31 wherein the anvil is further comprised of means for generating at

least three points of contact between the movable mandrel and an inside diameter (ID) of the pipe.

33. (Previously presented) The system as defined in claim 32 wherein the anvil for generating the at least three points of contact between the anvil and the ID of the pipe is further comprised of a plurality of pistons, wherein the plurality of pistons are independently controllable to thereby enable at least points to always be in contact with the ID of the pipe.

34. (Previously presented) The system as defined in claim 33 wherein the plurality of pistons further comprises at least three hoops, wherein the at least three hoops are pushed by the plurality of pistons, wherein a middle hoop is disposed so as to apply a force opposite the friction stir welding tool, and wherein at least two outer hoops are disposed so as to provide a counter-force to the middle hoop.

35. (Previously presented) The system as defined in claim 34 wherein the at least three hoops can be moved around the ID of the pipe by the plurality of pistons.

36. (Previously presented) The system as defined in claim 35 wherein the means for moving the movable mandrel is further comprised of a plurality of wheels.

37. (Previously presented) A method of removing root defects from a friction stir welding joint in a workpiece, said method comprising the steps of:

(1) providing a friction stir welding tool having a shank a shoulder and a pin, and providing an opposing force underneath the workpiece, the opposing force including a surface having a dimple disposed therein, wherein the dimple enables the pin of the friction stir welding tool to extend beyond an edge of the workpiece to thereby remove root defects therefrom; and

(2) disposing a superabrasive material on at least a portion of the shoulder and the pin, wherein the superabrasive material is manufactured under an ultra high temperature and an ultra high pressure process, and wherein the friction stir welding tool is capable of functionally friction stir welding MMCs, ferrous alloys, non-ferrous alloys, and superalloys.

38. (Previously presented) A friction stir welding tool that is capable of removing root defects from a friction stir welding joint in a workpiece, said friction stir welding tool comprising:

a friction stir welding tool having a shank, a shoulder and

a pin;

a superabrasive material disposed on at least a portion of the shoulder and the pin, wherein the superabrasive material is manufactured under an ultra high temperature and an ultra high pressure process; and

an anvil for providing an opposing force to the friction stir welding tool from underneath the workpiece, wherein the anvil includes a dimple to thereby enable the pin to extend through the workpiece and remove root defects therefrom, and wherein the friction stir welding tool is capable of functionally friction stir welding MMCs, ferrous alloys, non-ferrous alloys, and superalloys.

39. (Previously presented) A friction stir welding tool that is capable of functionally friction stir welding pipes comprised of metal matrix composites (MMCs), ferrous alloys, non-ferrous alloys, and superalloys, said friction stir welding tool comprising:

a friction stir welding tool having a shank, a shoulder and a pin, wherein the friction stir tool is capable of extending and retracting along a central axis thereof;

an arm that is coupled at an angle to the friction stir welding tool;

a roller that is coupled to the arm opposite the friction

stir welding tool and coaxial with the central axis of friction stir welding tool; and

a superabrasive material disposed on at least a portion of the shoulder and the pin, wherein the superabrasive material is manufactured under an ultra high temperature and an ultra high pressure process, and wherein the friction stir welding tool is capable of functionally friction stir welding MMCs, ferrous alloys, non-ferrous alloys, and superalloys.

40. (Previously presented) A method for friction stir welding on an arcuate surface of a workpiece, said method comprising the steps of:

(1) providing a friction stir welding tool having a shank a shoulder and a pin, and providing an opposing force underneath the workpiece, wherein the pin is retractable to thereby enable the fiction stir welding process to end without having a run-off tab on the workpiece; and

(2) disposing a superabrasive material on at least a portion of the shoulder and the pin, wherein the superabrasive material is manufactured under an ultra high temperature and an ultra high pressure process, and wherein the friction stir welding tool is capable of functionally friction stir welding MMCs, ferrous alloys, non-ferrous alloys, and superalloys.

41. (Previously presented) A method for functionally friction stir welding togther two pipes comprised of high melting temperature ferrous and non-ferrous alloys, or superalloys, said method comprising the steps of:

(1) providing a friction stir welding tool having a superabrasive material disposed on at least a portion of the shoulder and the pin, wherein the friction stir welding tool is disposed on an outer diameter (OD) of the pipes;

(2) providing a ring of material disposed between the two pipes; and

(3) providing a support mandrel disposed against an inner diameter (ID) of the pipes so as to counteract a force applied by the friction stir welding tool to the OD.

42. (Previously presented) The method as defined in claim 41 wherein the method further comprises the step of providing a new material in the ring of material disposed between the ends of the pipes to thereby introduce the new material into a friction stir welding joint.

43. (Previously presented) The method as defined in claim 41 wherein the ring of material extends partially outside the OD of the pipes.

44. (Previously presented) The method as defined in claim 41 wherein the ring of material extends partially outside the OD and the ID of the pipes.

45. (Previously presented) The method as defined in claim 41 wherein the ring of material extends partially outside the ID of the pipes.

46. (Previously presented) The method as defined in claim 41 wherein the ring of material does not extends outside the OD or the ID of the pipes.